

*USE OF COMPONENT ANALYSES TO IDENTIFY
ACTIVE VARIABLES IN TREATMENT PACKAGES FOR
CHILDREN WITH FEEDING DISORDERS*

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We evaluated the separate components in treatment packages for food refusal of 4 young children. First, treatment packages were implemented until food acceptance improved. Next, a component analysis was conducted within a multielement or reversal design to identify the active components that facilitated food acceptance. The results indicated that escape extinction was always identified as an active variable when assessed; however, other variables, including positive reinforcement and noncontingent play, were also identified as active variables for 2 of the children. The results suggest that the component analysis was useful for identifying variables that affected food acceptance.

DESCRIPTORS: component analysis of treatment, food refusal, young children

Feeding problems encompass a variety of behaviors that include food refusal and selectivity (i.e., eating an inadequate variety of foods), inadequate food intake, self-feeding skill deficits, disruptive mealtime behaviors (e.g., tantrums, aggression, throwing utensils), inappropriate rate of food consumption, and rumination or vomiting (Babbitt, Hoch, & Coe, in press; Luiselli, 1989; O'Brien, Repp, Williams, & Christophersen, 1991). The effects of feeding difficulties range from increased parental stress to growth and developmental delays (e.g., Budd et al., 1992; Oates, Peacock, & Forrest, 1985). Treatment of behavioral feeding disorders most often involves multiple intervention procedures combined in a treatment package (Hoch, Bab-

bitt, Coe, Krell, & Hackbert, 1994; Johnson & Babbitt, 1993; Riordan, Iwata, Finney, Wohl, & Stanley, 1984; Singer, Nofer, Benson-Szekely, & Brooks, 1991; Werle, Murphy, & Budd, 1993). For example, in the study by Werle et al., the treatment for chronic food refusal included (a) verbal prompts to eat, (b) praise and preferred foods or activities for compliance, (c) planned ignoring or time-out for disruptive behavior, and (d) a correction procedure for food expulsion or attempts to leave the table. In the Johnson and Babbitt study, treatment included an antecedent manipulation (changes in textures and eating utensils), music or preferred foods for acceptances, and extinction.

There were two purposes for the current investigation. The first purpose was to add to the growing but still sparse literature on behavior treatments of severe pediatric feeding disorders. In this study, we provide four case examples of young children who received relatively brief (3 to 31 days) inpatient treatment. The second purpose was to provide a methodology for conducting posttreatment analyses of the treatment packages. For each child, a multicomponent treatment package was implemented. Following the initial improvement in behavior, selected

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variables were removed from the package to evaluate their independent contributions.

Wacker *et al.* (1990) conducted this type of analysis following the successful treatment of self-injury and aggression. The investigators removed the key components of the treatment package in a series of brief reversal conditions to identify the effects of treatment components on aberrant behavior. A similar approach appeared to have merit for assessing individual components in treatment packages for food refusal.

In this study, a multicomponent treatment package was implemented first, and once treatment resulted in improved food acceptance, a component analysis was conducted to identify which components facilitated ongoing food acceptance. The use of a posttreatment component analysis was appealing from a clinical standpoint because it permitted us to initiate treatment more quickly than if a pretreatment assessment had been conducted (e.g., sequential inclusion of separate components). From a procedural standpoint, it also provided a methodology for evaluating active variables that appeared to be necessary for ongoing (postdischarge) treatment. This information could provide a rationale to care providers regarding the need for individual components of the treatment package, and, in some cases, could eliminate one or more components that appeared to be unnecessary.

METHOD

Participants and Settings

Jack was 1 year 9 months of age and had been diagnosed with failure to thrive and language delays. By parent report, Jack independently drank from a sipper cup and fed himself a limited number of finger foods. Attempts to feed nonpreferred food or verbally prompting him to eat resulted in active food refusal including screaming, pushing away the food or spoon, clenching his teeth, placing his fingers in his mouth to induce gagging, and spitting

out accepted bites. Jack's oral-motor and swallowing skills permitted safe consumption of all food and drinks by mouth. Jack was admitted to the inpatient unit for 31 days for evaluation of failure to thrive, with our evaluation completed in 19 days. At the time of admission, Jack's weight and growth velocity (i.e., average weight gain per day) were below the 5th percentile based on his weight and age, suggesting inadequate caloric intake (i.e., less than 1,100 kcal per day). Due to the severity of Jack's malnutrition, nighttime nasogastric (NG) feedings (consisting of half of his daily caloric needs) were implemented for the first 11 days of admission; nighttime feedings ended at least 4 hr prior to breakfast. Goals for Jack included increasing his oral caloric intake to at least 1,100 kcal per day and increasing his rate of growth.

Carl was 6 years 2 months of age and had been diagnosed with oxygen-dependent bronchopulmonary dysplasia (BPD) and severe developmental delays. He was nonambulatory and nonverbal, but was able to reach, grasp, and point to items, and was learning to use picture cards to communicate. The initial portion of the feeding evaluation occurred while Carl was an inpatient for a bronchoscopy and decannulation. He received all of his nutrition via gastrostomy tube, and evaluation of his oral-motor and swallowing skills suggested that he could not safely consume more than tastes of solids. He was described as being orally "hypersensitive"; when presented with tastes of food, he slapped at the spoon, or when tastes were accepted into his mouth, he wiped them off his tongue or lips with his fingers. The evaluation occurred for 3 days during his hospitalization and once per week for 21 weeks in his home. Goals for Carl were to increase his acceptance of small tastes of pureed foods on a spoon and compliance during a mealtime routine until he could safely eat quantities of food.

Andy was 2 years 11 months of age and had been diagnosed with short-bowel syndrome and developmental delays in all areas except motor skills. Andy produced some sounds but did not

communicate verbally. He had a history of multiple surgeries for lengthening his intestines and for central line infections and, therefore, had spent the majority of his life (all but 86 days) in the hospital. He received all nutrition via gastrostomy tube and central venous line, and sometimes had episodes of emesis or excess stooling related to ongoing gastrointestinal difficulties. However, he did not have any oral-motor or swallowing dysfunction that prevented oral consumption of food. Nursing staff had attempted to conduct oral feedings of pureed foods for several months prior to the present study. Andy independently drank sips of water from a tippee cup but did not use a spoon and refused attempts to feed him. Food refusal consisted of screaming, shaking his head, clenching his teeth, batting at the spoon with his hands, throwing food off of his tray, and spitting. The evaluation occurred over 30 days during a hospitalization for additional surgery. Medical and nursing staff expected that Andy would continue to receive all or most of his nutrition through the gastrostomy tube or a central line indefinitely, but their goal was to increase his acceptance of food by mouth prior to discharge home.

Karen was 1 year 8 months of age and had been diagnosed with steroid and oxygen-dependent BPD. She received oxygen by nasal cannula. A developmental assessment indicated delays in all areas. Karen was able to sit independently and crawl. She babbled, but spoke only two words. She received all nutritional needs via a gastrostomy tube at the time of the evaluation. She had consumed up to 75% of her total caloric intake by mouth until she contracted a viral illness at 2 months of age; subsequently, her intake decreased until she stopped all oral feedings at 8 months of age. She had no oral-motor or swallowing dysfunction. Attempts to feed Karen resulted in screaming, slapping and pinching the feeder, pulling her own hair, clenching her teeth, pushing away the spoon or food, and gagging. Karen sometimes began gagging or slapping when first placed in the high

chair, prior to the presentation of food. She was evaluated during a 15-day inpatient admission. Goals for Karen were to develop a treatment plan for her parents to implement at home to increase her oral acceptance of food.

All meals in the hospital were conducted in the children's rooms on the inpatient unit. Jack was served food from the standard hospital children's menu, which consisted of items designed to provide a balanced diet but with "boosted" calories (e.g., added margarine, gravy, cheese). Because Carl, Andy, and Karen were inexperienced eaters, baby soft foods (e.g., purees, mashed potatoes) were offered during the meals. Andy was allergic to a number of foods, and products using milk, eggs, or peanuts could not be offered. Follow-up for Jack occurred during a routine outpatient visit. Evaluation and follow-up for Carl, Andy, and Karen occurred in the children's homes during the normal meal routine.

Dependent Variables

For Jack, Andy, and Karen, the primary dependent variable was the number of bites or sips (Andy only) accepted during each 20-min meal. For Carl, the primary measure was the number of tastes of food accepted without wiping the food out with his fingers during each 15-min meal. A second, related measure was the number of 10-s intervals in which Carl either placed his fingers in or near his mouth or expelled food with his fingers. For all children, a bite (or taste, for Carl) was scored as accepted when (a) the child opened his or her mouth and the food was deposited inside when the bite was offered on the spoon, or (b) the child independently placed a bite of food into his or her mouth using the spoon or fingers. For Andy, sips of fluid were also scored as accepted "bites" if, when the tippee cup was offered, he opened his mouth, the spout of the cup was inserted past the teeth, and at least one swallow occurred. A bite was scored as expelled if, prior to a new bite offer, the child spit out the food, used his or her fingers to expel the food, or engaged in

any form of behavior that resulted in removal of the food or fluid from the mouth. If a bite was reoffered immediately following expulsion (escape extinction), it was not scored as constituting a second bite; regardless of the number of reoffers, only one bite was scored.

For all cases the number of bites accepted, instead of percentage of bites accepted, was chosen as the primary dependent measure. This was done because it was observed that parents or nursing staff often terminated meals when the child began to refuse food or to have tantrums, after the child had accepted a small number (but high percentage) of bites of preferred food.

For Andy and Karen, the quantity of food (in cubic centimeters) consumed in each meal was also recorded in order to measure progress with food intake. For Jack, daily caloric intake (in kilocalories) was calculated by the hospital dietitian. In addition, because increased rate of weight gain was a goal for Jack, daily weight (in kilograms) was measured. No measure of food quantity was obtained for Carl because he was unable to safely accept more than tastes of food.

Observation System and Interrater Agreement

Number of bites accepted was recorded using an event recording system. For Carl, occurrence of fingers in his mouth and expulsions were recorded using a 10-s partial-interval recording system.

For all children, interrater agreement was evaluated during sessions or by observation of videotaped sessions by having a second observer simultaneously but independently record the target behaviors. For bites accepted, occurrence agreement was calculated on a point-by-point basis by dividing the number of acceptance agreements by the number of acceptance agreements plus disagreements and multiplying by 100%. Agreement for finger mouthing or expulsions (Carl only) was defined as both observers scoring the same behavior in the same interval. Agreement for finger mouthing or ex-

pulsions was calculated on an interval-by-interval basis and was computed by dividing the number of agreements by agreements plus disagreements and multiplying by 100%. Agreement for bite acceptances was evaluated during 10 sessions (29% of total) for Jack, 10 sessions (28% of total) for Carl, 30 sessions (38% of total) for Andy, and 22 sessions (33% of total) for Karen. Occurrence agreement for bites accepted averaged 98% for Jack (range, 95% to 100%), 98% for Carl (range, 94% to 100%), 99% for Andy (range, 91% to 100%), and 99% for Karen (range, 87% to 100%). Total (occurrence plus nonoccurrence) agreement for Carl was always above 90%. Occurrence agreement for Carl for finger mouthing or expulsions averaged 95% (range, 86% to 100%).

For quantities consumed (Andy and Karen), the therapist measured all available food before and after each meal and weighed the bib placed on the child before and after each meal in order to estimate the amount of food ingested. Post-meal weight was subtracted from premeal weight to obtain an estimate of amount consumed. Interrater agreement was conducted only for Andy. One of the experimenters or a nurse conducted these measurements independently of the therapist during 18 meals (23% of total). Agreement was computed by dividing the smaller amount by the larger amount. Agreement averaged 93% (range, 83% to 100%). For Jack, daily caloric intake was calculated by the hospital dietitian. First, the amount of food and drink consumed was estimated at the end of each meal and recorded on a calorie intake sheet. Then the dietitian calculated the total calories consumed each day.

Design

A four-phase analysis was conducted with Jack, Andy, and Karen: baseline, treatment package, component analysis, and follow-up. The first three phases were conducted with Carl. For Jack, Carl, and Andy, baseline sessions were conducted on the inpatient unit. For Karen, baseline sessions were conducted on 3 sep-

arate days in an outpatient clinic associated with the inpatient unit, and two sessions were conducted on the inpatient unit. Treatment involved a multicomponent package that always included positive and negative reinforcement components. Following treatment, a component analysis was conducted for Jack, Carl, and Andy within a reversal design. This was accomplished by removing and then reimplementing specific components, which were selected based on practical concerns or hypotheses regarding the variables that were currently maintaining appropriate eating and mealtime behavior. For Karen, the component analysis was conducted within a multielement design. Follow-up probes were conducted for up to 6 months following discharge.

Procedures

General. Baseline sessions for Karen and Carl were conducted by the children's parents (Jack's mother and Andy's parents were not present consistently during their admission). During baseline, the parents were told to use the procedures they normally used. A trained observer collected narrative data on antecedent behaviors, target behaviors, and consequences (A-B-C data) to generate hypotheses about the children's behavior. Given the severe, chronic feeding problems displayed by these patients and the brevity of their inpatient admissions, baseline phases were as short as possible and were used primarily to generate the initial treatment packages. Following baseline, therapists conducted all treatment sessions for Jack, Andy, and Karen using individually constructed treatment packages. For Carl, sessions were conducted by his parents at their request. When behavior stabilized or reached the goal established by the admitting medical staff, the component analysis was conducted by therapists or by Carl's parents. Components were selected for evaluation based on their hypothesized effect on the target behavior (removal might confirm the necessity of their inclusion in the package) or complexity (complex procedures might be elim-

inated if no effect was observed on target behavior). During treatment and the component analysis, bite offers were presented at a rate of approximately two per minute. However, rate was also determined by the child's acceptance of bites; rate increased with increased acceptances and decreased with occurrences of refusal when treatment included escape extinction. Thus, for each child a minimum expected number of bites could be calculated (i.e., 30 bites in 15 min, 40 bites in 20 min). If few or brief refusals occurred, then bites should exceed the minimum. Five meals were conducted daily with Jack, Karen, and Carl, and three were conducted with Andy. Follow-up, consisting of in-home probes, was conducted by parents. All meals on the inpatient unit and at follow-up were conducted with the child secured in a high chair (or in a chair at a table for Carl).

Procedures for Jack. Baseline was conducted over seven meals. Baseline meals lasted an average of 19 min (range, 16 to 20 min). Based on the descriptive assessment, this variability appeared to be related to whether or not Jack received preferred foods (e.g., yogurt, meat) or drinks (juice) from the nursing staff. When he was offered nonpreferred food, he refused food until a preferred item was offered.

During treatment, nutritious high-calorie foods were offered as choices at each meal. Three to four bites of each target food were placed on a plate in front of him with a spoon. If he touched a food or in any other way indicated a choice, he was offered that bite of food. If he did not indicate a choice within approximately 5 s, the therapist chose a bite of food, alternating among the choices. Food was replaced when all items had been eaten. Jack was prompted to eat independently by handing him the bite or spoon of the selected food. For each bite accepted independently and without refusal, he was praised and provided with a choice of preferred food or drink (identified during baseline) on a bite-for-bite basis. If he engaged in food refusal, the preferred food or drink was not provided and escape extinction

was implemented. Food refusal (including refusal to hold the spoon or bite when prompted) resulted in the therapist placing the bite at or on his lips, following his mouth if necessary, until he accepted the bite (i.e., opened his mouth, leaned forward to accept it, closed his mouth on the spoon). Any bite spit out was reoffered in the same manner until it was accepted and remained in his mouth. Attempts to push away the spoon or food resulted in neutral blocking and redirection of his hand toward the tray, but hand-over-hand physical guidance or restraint was not implemented. Meals lasted for 20 min or until he accepted the bite being offered when time elapsed.

Escape extinction was removed from the package during the component analysis (all other components remained). This was completed in two sessions, and was followed by a return to the entire treatment package (including escape extinction) for eight sessions. The removal of escape extinction was conducted using a novel therapist who had interacted with Jack outside of meals and had collected data, and who was a trained member of the feeding team but was not associated with the treatment package. A novel therapist was used to lessen the possibility that decreases in food acceptance resulting from the removal of escape extinction would persist after it was reinstated. That is, we did not want one of Jack's regular therapists to become a discriminative stimulus for negative reinforcement of food refusal.

Jack's nurses and mother were trained in the use of the treatment package. One month following discharge, a follow-up observation, with his mother as therapist, was conducted in the outpatient clinic during a 20-min meal.

Procedures for Carl. The two baseline sessions lasted 14 and 15 min. During baseline, Carl's mother praised him for accepting bites of food, reprimanded him when he expelled the bites with his fingers, and permitted him to escape bites of food (i.e., expelled items were not re-presented). Outside of meal times, it was noted that Carl played with several preferred toys and

engaged in positive interactions with his parents.

The treatment package included contingent attention (praise), brief (15 to 30 s) access to a toy for accepting bites that were not expelled before the next bite was presented, and escape extinction (as described for Jack). If Carl expelled any bites while playing with the toy, the toy was immediately removed and a new bite of the same food was presented. Meals lasted for 15 min or until he accepted the bite being offered when time elapsed. Given his brief inpatient stay, his parents requested to conduct all sessions with coaching from therapists.

Three in-home observation probes (Sessions 15 through 17), consisting of the entire package, were conducted during the next 4 weeks by his mother. Following these three probes, the component analysis was conducted by his mother with coaching from therapists. First, for 3 weeks (one session per week), toys were removed from the package but contingent parental praise and escape extinction continued. Second, the entire package was reimplemented and probed on nine occasions over 3 months. Third, parental attention was removed during three probes conducted over 5 weeks. Finally, the entire package was reimplemented during four probes over 5 weeks. All in-home probes lasted 15 min, and escape extinction was never removed per parent request.

Procedures for Andy. Andy had never eaten independently but occasionally accepted small sips of water from a tippee cup. During five baseline sessions, the procedures typically used by nursing staff were implemented during 20-min meals conducted by the therapists: They provided brief (30 s) toy play, praise, and social interactions contingent on each acceptance of food or drink. Rejected bites were re-presented following a delay of approximately 5 to 10 s. The treatment package involved three primary components: (a) noncontingent access to toys and social interactions throughout the meal as distractors, (b) escape extinction (as described for Jack), and (c) praise and a sip of liquid contingent on accep-

tances that remained in his mouth. Thus, when a bite was presented, it was held at or on Andy's lips. If he moved his head, the spoon was moved so that it remained at or on his lips. Toy play and social interactions occurred while the bite was presented, regardless of Andy's behavior. When the bite was accepted, he was provided praise and a sip of liquid. Meals lasted for 20 min or until he accepted the bite being offered when time elapsed. This treatment package was implemented for 24 meals and was followed by the component analysis.

During the component analysis, the component consisting of noncontingent toys and social interactions was removed first and was followed by a return to the entire treatment package. Noncontingent access to toys was removed first because of the practical problems associated with having toys on his tray during meals. Next, the escape extinction component was removed (using a novel therapist in the same manner as with Jack). This was followed by a return to the entire treatment package for 34 sessions with therapists or nursing staff. Treatment was discontinued when Andy underwent further bowel surgery and was resumed 1 month later with intermittent use of food (due to ongoing medical procedures). If Andy displayed emesis during a meal, he was cleaned up, and nursing or medical staff determined the necessity of terminating the session due to medical concerns. When escape extinction was in place, Andy was required to take a bite or sip prior to ending the session. If Andy attempted to bat at the spoon during treatment, his arm was blocked and redirected to the toys when they were present, or it was redirected to the tray when the toys were absent. However, physical restraint or hand-over-hand guidance was not implemented. Parents were trained prior to Andy's discharge. In-home follow-up probes were conducted every 2 weeks for 4 months following discharge. Follow-up meals were conducted under natural conditions and lasted 20 to 36 min ($M = 23$ min).

Procedures for Karen. Three outpatient base-

line sessions, averaging 10 min (range, 7 to 13 min), preceded two 21-min inpatient baseline sessions. Karen's mother reported extreme frustration with Karen's behavior and indicated that she often gave up, resulting in meals of less than 10 min. During baseline, Karen's mother placed a number of bites in Karen's mouth when Karen screamed or cried (resulting in gagging or coughing). She also held Karen's hands down in her lap when feeding her. Karen intermittently showed preferences for certain foods. She also showed preferences for certain toys and was responsive to adult attention. The treatment package included (a) a 5-min warm-up prior to each meal, (b) the presentation of two foods as a choice, (c) enthusiastic praise delivered contingent on each acceptance, and (d) escape extinction (as described for Jack). During the warm-up period, Karen was placed in her high chair and played with preferred toys with the therapist. This procedure was implemented because of her negative responses associated with placement in her high chair. Warm-up was used to pair potential positive reinforcers with sitting in her high chair to try to reduce these inappropriate behaviors. The choice component involved offering her two spoons with different food items. If she touched a spoon or in any other way indicated a choice, she was offered that bite of food. If she did not indicate a choice within approximately 5 s, the therapist chose one of the spoons, alternating between the choices. For each bite accepted, she was praised. If Karen attempted to hit a spoon or the therapist when escape extinction was in place, her hand was physically guided to hold the spoon. Meals were targeted to last 15 to 20 min or until she accepted the bite being offered when time elapsed. Meals lasted an average of 16 min (range, 13 to 20 min). On four occasions, meals were terminated a minute or two early (e.g., 13 min) so that the meal ended after an acceptance and delivery of the reinforcer. Treatment was implemented for 11 sessions and was followed by the component analysis.

During the first phase of the component

analysis, choice was compared to no choice in a counterbalanced order across meals. All other components remained the same for both conditions. Choices were subsequently eliminated from the package, and the warm-up component was compared to no warm-up, with contingent attention and escape extinction in place for both conditions. Next, the warm-up condition was removed, and escape extinction was compared to no escape extinction, with contingent attention in both conditions. During conditions in which escape was permitted, a novel therapist conducted the sessions as described for Jack. The final treatment package, conducted for 16 sessions, included contingent praise plus escape extinction. During the final day of hospitalization, Karen's parents were trained to implement the procedures, and one probe was conducted during which the therapist was present only to collect data. In-home follow-ups were conducted over the next 6 months with her parents on approximately a monthly basis. Follow-up meals lasted 19 to 20 min ($M = 20$ min).

RESULTS

The results for Jack are provided in the top panel of Figure 1. During baseline, Jack accepted an average of 23 bites (range, 5 to 35) and orally consumed an average of 715 kcal (range, 680 to 765). The majority of food accepted was fed to him ($M = 73\%$) and consisted almost exclusively of preferred foods. Although meal length varied, there was no apparent correlation between length of meal and number of bites accepted (e.g., the second, fifth, and sixth meals of baseline lasted less than 20 min). When the treatment package was implemented, Jack accepted an average of 35 bites (range, 1 to 61). The number of bites accepted was low for the first three treatment sessions, increased markedly over the next four sessions, and stabilized between 40 and 60 bites per meal for the last 11 meals ($M = 50$). In addition, the mean percentage of bites accepted independently (i.e., self-fed bites) increased from 27%

during baseline to 78% during treatment (range, 0 to 100%). When escape extinction was removed from the treatment package, the number of acceptances decreased to 38 and 20, respectively, but the percentage of independent bites remained high (89% and 100%, respectively). An increase in acceptances occurred when escape extinction was reinstated ($M = 55$; range, 44 to 65) and independent bites remained high ($M = 89\%$; range, 68% to 98%). Caloric intake ranged from 245 kcal (first day of treatment) to 1,635 kcal (last day of treatment) and averaged 1,280 kcal over the last 3 days of treatment. Jack's mother was trained in the treatment package prior to discharge.

At the time of discharge, Jack had gained 510 g, placing his growth velocity above the 90th percentile for his age. At 1 month following discharge, Jack accepted 46 bites (96% independently) during the meal with his mother. He had gained 140 g, placing his growth velocity between the 50th and 75th percentile for his age.

The results for Carl are presented in the bottom panel of Figure 1. During the two baseline sessions, Carl accepted a relatively large number of offers (29 and 28 bites, respectively), but he also displayed a substantial amount of manual expulsions (24 and 23 intervals, respectively). The treatment package resulted in a brief decrease and then a consistent improvement in acceptances ($M = 34$ bites; range, 18 to 41), but the number of finger mouthing or expulsions per session was variable until the final six sessions. During these final six sessions, bites accepted averaged 37 (range, 31 to 41) and finger mouthing or expulsions averaged 16 intervals (range, 13 to 21). Continued improvement in acceptances and finger mouthing or expulsions occurred with ongoing treatment at home ($M = 40$ bites accepted, five intervals with finger mouthing or expulsions). When toys were removed as a reinforcer during the first phase of the component analysis, a slight but consistent decline in his acceptances occurred ($M = 30$ bites), and finger mouthing or expulsions increased ($M = 10$ intervals). Both behaviors im-

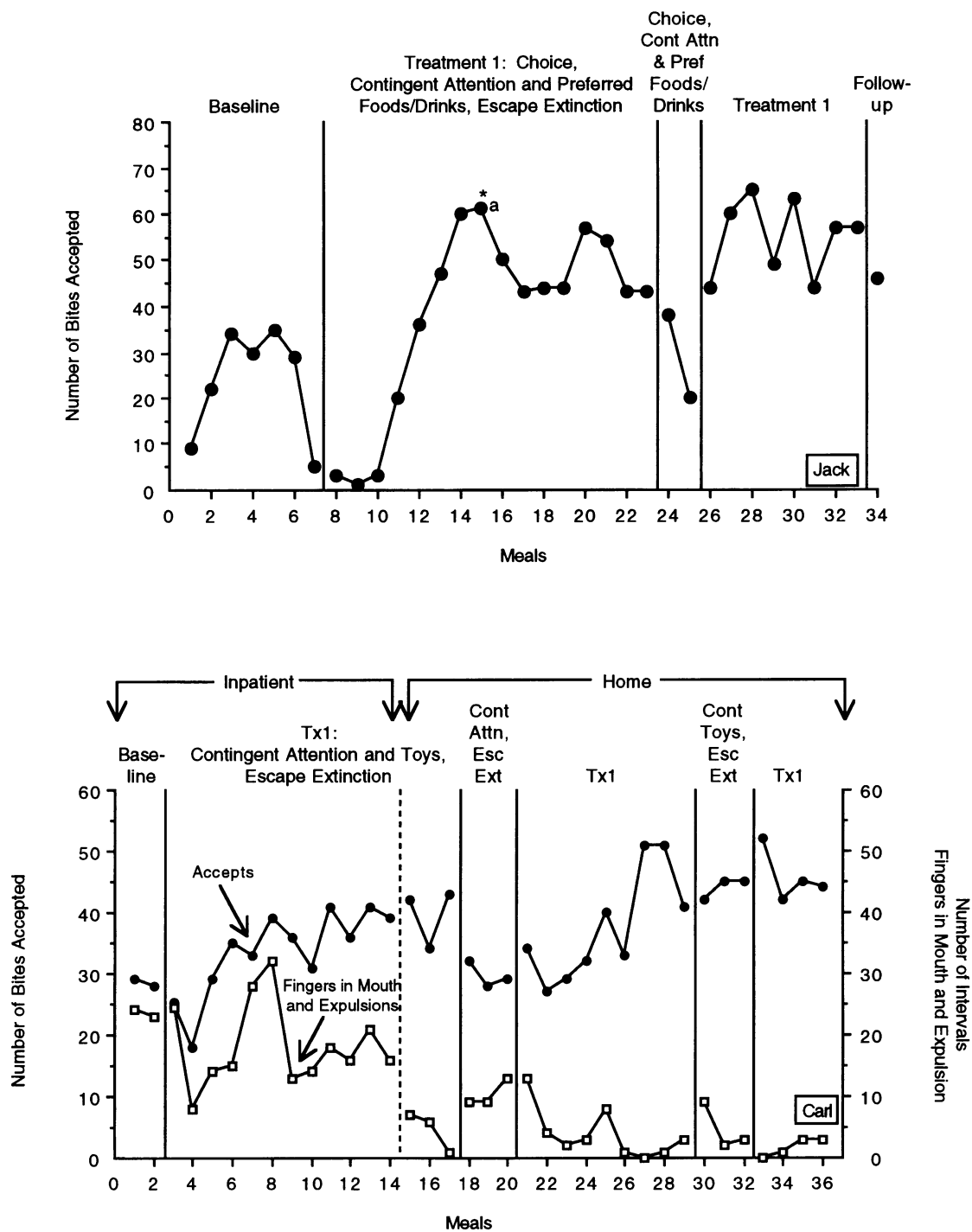


Figure 1. Top panel: number of bites accepted across conditions for Jack. *a indicates discontinuation of NG feedings. Bottom panel: number of bites accepted and intervals of fingers in mouth/expulsion across conditions for Carl.

proved with the reimplementation of the entire treatment package over the next 3-month period ($M = 38$ bites and four intervals of finger mouthing or expulsions; range, 29 to 51 bites and 0 to 13 intervals, respectively). The removal of attention appeared to have little effect on number of bites accepted ($M = 44$ bites) but was associated with an initial slight increase in the finger mouthing or expulsions ($M = 5$ intervals, primarily finger mouthing), which appeared to correlate with irritability and crying. As a result, his parents elected to include attention in the treatment package but on a more intermittent basis. This was accomplished by providing attention to Carl and his brother (who also ate at the table) in an alternating manner. The entire package was then reimplemented (with intermittent attention, approximately every two to three bites), with similar positive results ($M = 46$ bites and two intervals of finger mouthing or expulsions).

The results for Andy are provided in Figure 2, with the top panel showing bites accepted and the bottom panel showing amount consumed. During baseline, Andy often accepted drink offers ($M = 18$; range, 12 to 29) but did not consume measurable amounts of solids or liquids. He generally took very small sips of liquid and had tantrums whenever food was offered. After about three sessions, the treatment package resulted in consistent and sustained improvement in both acceptances ($M = 57$; range, 10 to 93) and amount consumed ($M = 33$ cc; range, 0 to 68). When noncontingent toy play and social interactions were removed from the treatment package, bites accepted and amounts consumed decreased substantially ($M = 27$ bites, range, 9 to 49; $M = 23$ cc, range, 0 to 58). When the noncontingent reinforcement component was reinstated, bites accepted ($M = 65$; range, 58 to 76) and amounts consumed ($M = 50$ cc; range, 44 to 56) increased. Similarly, bites accepted and amount consumed decreased when escape extinction was removed from the package ($M = 23$ bites, range, 18 to 31; $M = 4$ cc, range, 0 to 12), and increases in both measures occurred

when this component was reinstated ($M = 65$ bites, range, 10 to 100; $M = 58$ cc, range, 0 to 115). During follow-up probes, Andy accepted fewer bites than during inpatient treatment ($M = 49$) but more than during baseline. At 19 months follow-up, Andy consumed 26% of his calories orally, and at 24 months, oral consumption accounted for 42% of his calories. Prior to treatment, he had never consumed a substantial number of calories orally.

The results for Karen are presented in Figure 3. During outpatient baseline, Karen displayed a decreasing trend in the number of bites accepted; this corresponded to reports by parents and the outpatient team that oral intake typically was below 10 cc. During her two inpatient baseline sessions, she also consumed less than 10 cc. No correlation was noted between length of meals and number of bites accepted during baseline (e.g., the first three baseline meals were less than 20 min and the final two more than 20 min).

The treatment package resulted in immediate but variable improvement in the bites accepted ($M = 40$; range, 18 to 58), and in a delayed, modest improvement in the amount consumed ($M = 20$ cc; range, 10 to 60). During the third phase, increases were observed in the number of bites accepted and amount consumed in the condition in which the full treatment package was still in effect and in the condition in which the choice component was excluded from the package. However, no clear differences were observed between the two conditions, suggesting that the choice component was not essential. Based on these findings, the choice component was removed from the package for the remainder of the study. Similarly, the warm-up component appeared to have only a minimal effect, especially on amount consumed, and was also removed. However, when escape extinction was removed from the package, substantial decreases occurred in both bites accepted ($M = 12$; range, 11 to 14) and amount consumed ($M = 6$ cc; range, 0 to 12) relative to when it was included in the package ($M = 40$ bites, range, 35 to 43; $M = 43$ cc, range, 40 to 48). The final treat-

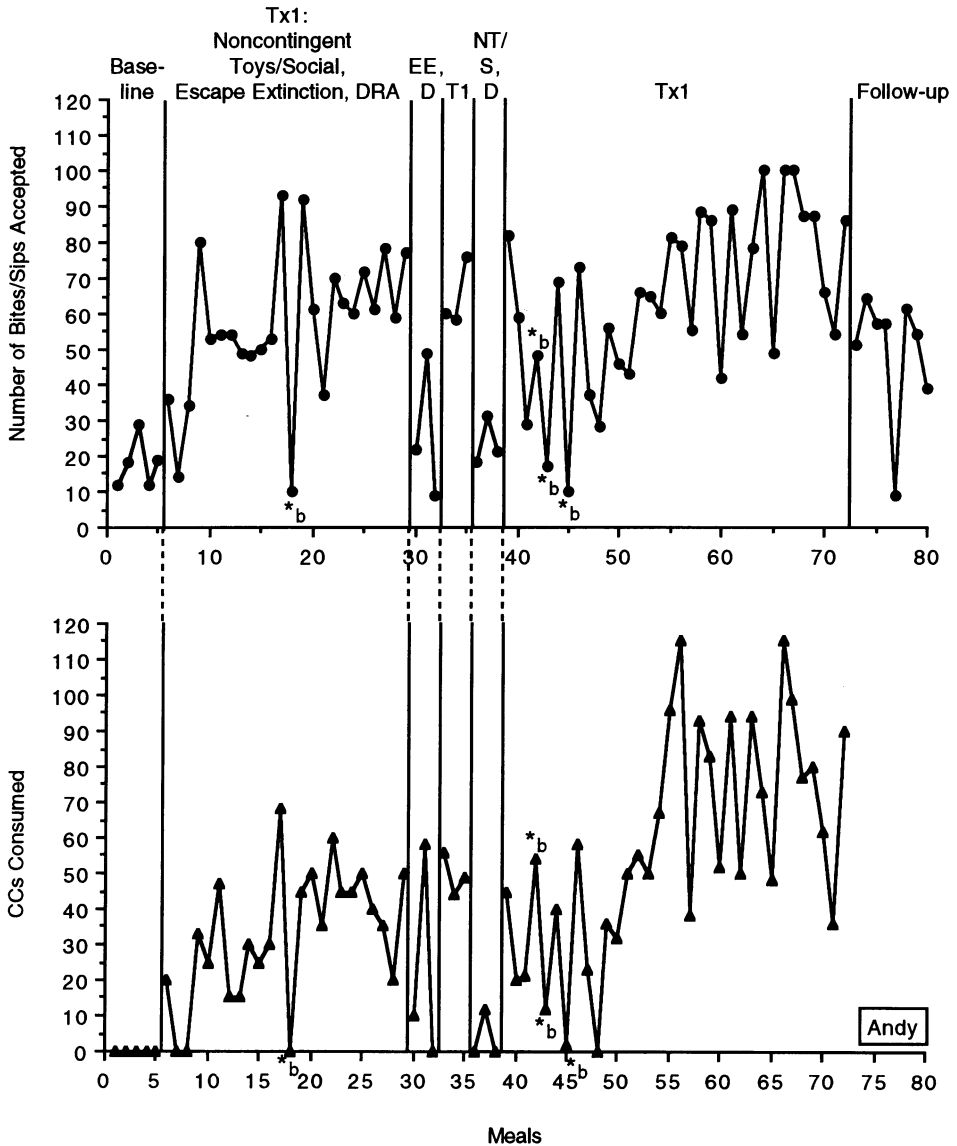


Figure 2. Number of bites accepted (top panel) and quantity consumed (bottom panel) across conditions for Andy. *b indicates meals that ended early due to medical concerns. EE/D = escape extinction, DRA; T1 = Treatment 1; NT/S, D = noncontingent toys/social, DRA.

ment package, consisting of escape extinction and contingent attention, was reinstated with good results. Both bites accepted and amount consumed increased consistently ($M = 56$ bites, range, 27 to 75; $M = 81$ cc, range, 40 to 130) and allowed medical staff to reduce the amount of supplement given by gastrostomy tube by more than one third.

Karen's parents learned these procedures on

the inpatient unit and used them successfully for about 3 months. After 1 month, medical staff discontinued gastrostomy tube feedings because of her improvement in oral feedings. Unfortunately, after 3 months, in-home probes showed no improvement over baseline during the final three sessions. Anecdotal observations by the examiners during the in-home probes suggested that the parents used the same pro-

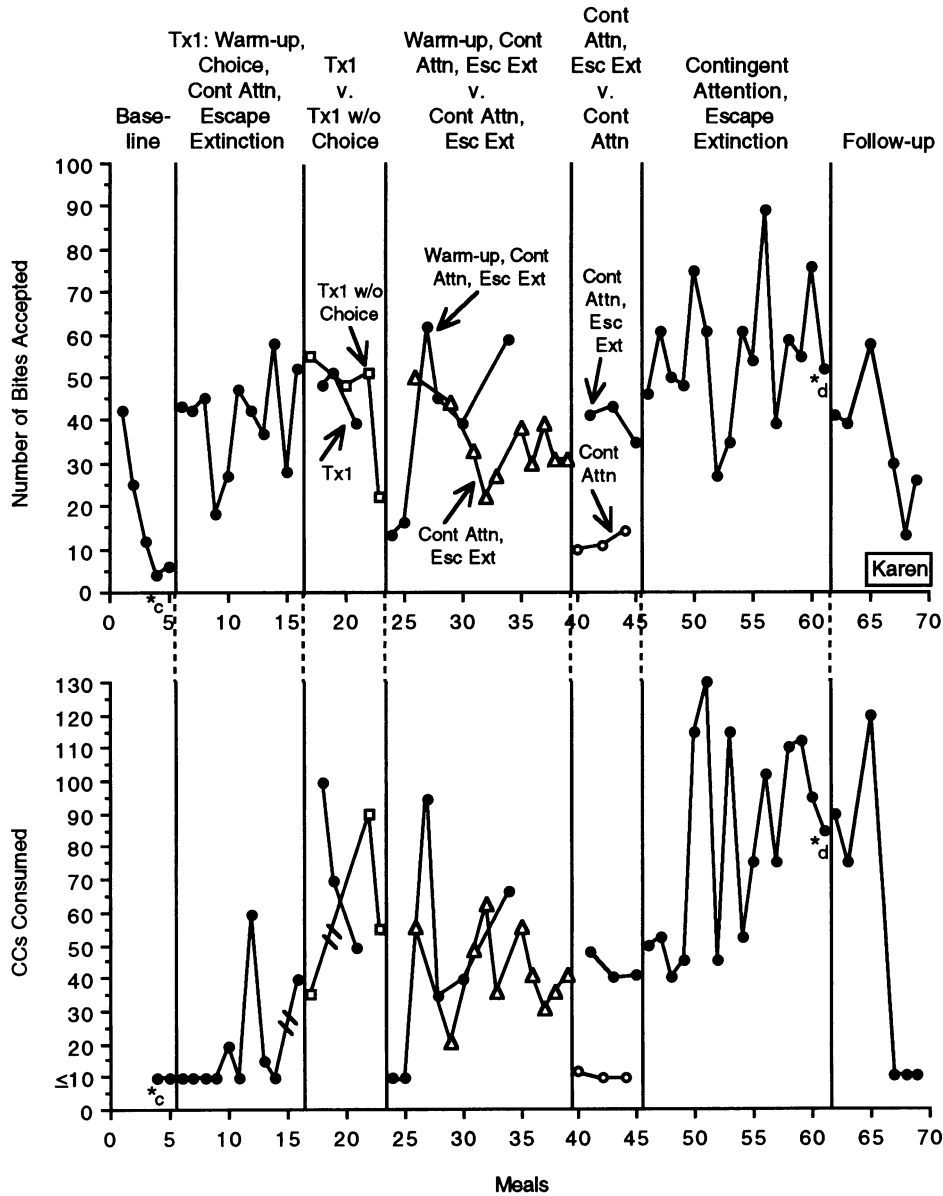


Figure 3. Number of bites accepted (top panel) and quantity consumed (bottom panel) across conditions for Karen. *c indicates beginning of inpatient evaluation, and *d indicates parent training probe.

cedures as during baseline. The parents chose to discontinue use of the treatment procedures, and follow-up by the experimenters was discontinued. However, 24 months following discharge, her parents reported that they had reimplemented the treatment package (contingent praise plus escape extinction) and Karen orally consumed 100% of her caloric needs.

DISCUSSION

These four cases provide additional support for the use of behavioral treatments with severe pediatric feeding disorders. All 4 children with chronic and severe feeding problems demonstrated improved behavior relatively quickly on the inpatient unit. Their overall responsiveness to the behavioral treatments replicates previous

findings (e.g., Hoch et al., 1994; Johnson & Babbitt, 1993; Riordan et al., 1984; Werle et al., 1993). The relatively quick results are important from a clinical perspective because there is increasing pressure to reduce the length of hospital stays. Thus, improvements in severe feeding problems are sometimes possible with behavioral treatments, even when the length of treatment is relatively brief.

The results of follow-up were less impressive. Karen's family discontinued the treatment, and Andy's family experienced problems. Although Andy's illnesses and subsequent surgeries undoubtedly contributed to these problems, further analyses of the long-term use of the treatment appear to be warranted. For example, the length of time in a controlled treatment setting may correlate with long-term successful results. In spite of these difficulties, the original goals were eventually achieved for all children (Andy consumed 42% of his calories orally, and Karen consumed all of her calories by mouth).

In addition, the posttreatment component analysis appeared to be useful for identifying essential and nonessential treatment components with these children. For example, the effects of escape extinction were evaluated with Jack; this procedure was shown to be necessary for maintenance of treatment effects. Contingent access to toys was evaluated with Carl and appeared to be necessary for maintaining low levels of finger mouthing or expulsions, and also may have had some beneficial effect on the number of bites accepted. Contingent access to attention was also evaluated with Carl. Although this component appeared to have little effect on the number of bites accepted or finger mouthing or expulsions, it was kept in the package due to anecdotal observations that crying and irritability increased when it was removed. However, the short baseline and reversal phases, combined with the small and variable changes in response levels, preclude any firm conclusions for Carl.

The effects of noncontingent reinforcement (i.e., free access to toys and social attention) and

escape extinction were independently evaluated with Andy. Removal of each procedure from the treatment package was associated with marked decreases in bites accepted and amount consumed, indicating that noncontingent reinforcement (with either attention, toys, or both) and escape extinction were necessary for maintenance.

With Karen, the effects of escape extinction, a choice procedure (allowing her to choose between two foods during each bite presentation), and a premeal warm-up period (consisting of Karen and the therapist playing together with toys) were each independently evaluated during the component analysis. The removal of escape extinction from the treatment package was associated with marked reductions in bites accepted and amount consumed. No clear differences in the number of bites accepted or amount consumed were associated with either the choice or warm-up procedures; hence, both were eliminated from the treatment package. Thus, in Karen's case, the results of the post-treatment analyses indicated that escape extinction was necessary for maintenance of treatment effects and suggested that the choice and warm-up components were not. These conclusions are further supported by the fact that Karen showed continued improvement during the final phase of treatment in the hospital when the treatment package included escape extinction but not the choice or warm-up procedures.

Only one treatment component—escape extinction—was independently evaluated with several patients (Jack, Andy, and Karen), and was shown to be a necessary treatment component in each case. Hoch et al. (1994) also found escape extinction to be a necessary treatment component in 2 patients with severe feeding problems. Taken together, these two studies provide additional support for the hypothesis that severe feeding problems displayed by young children and persons with developmental disabilities can be partially, and in some cases primarily, maintained by negative reinforcement (Iwata, 1987; Riordan et al., 1984).

One potential advantage of a posttreatment component analysis is that multiple treatment components are implemented initially, thus increasing the likelihood of rapid clinical improvement. A second advantage is that this approach focuses on identifying the variables necessary for maintenance. The methodology used by Hoch *et al.* (1994) provides a distinctly different approach for identifying active variables and involves the sequential introduction of treatment components. There are at least two advantages to this latter approach. First, the sequential approach, if it begins with the least intrusive variables, may eliminate the need to use more intrusive variables for most children. Second, it can avoid the possible confounding effects of variables that have been paired. The selection of one methodology over the other appears to be related to the outcome of most interest. If an analysis of variables needed for the initiation of treatment is of most interest, the methodology used by Hoch *et al.* (1994) would be preferred. If, instead, the variables related to maintenance are of most interest, then a component analysis is indicated following treatment. It also may be of interest to conduct brief component analyses at different times during treatment to determine whether active variables change over the course of treatment.

Two limitations should be considered in interpreting these results. First, because of time constraints, the length of baseline and conditions within the component analysis were quite brief. Thus, the stability of the findings remains unknown. This is of particular concern when the decision is made to eliminate "unnecessary" treatment components. It seems possible that over several sessions, the effects correlated with a given variable may increase. Second, the length of meals sometimes varied across sessions. This is of potential concern because number of bites accepted during a meal may be a function of the length of the meal. Although length of meals and number of bites accepted did not appear to be correlated in our study, it would be best in future studies to standardize

length of meals or number of bite offers across conditions (e.g., Riordan *et al.*, 1984).

In summary, we interpret the findings of the current study as being positive relative to both purposes of the investigation. The treatments implemented had generally positive effects, and the component analysis appeared to have merit for evaluating specific variables relating to ongoing food acceptance.

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